

PETROLOGY AND GEOCHEMISTRY OF THE HIGH-PRESSURE NILGIRI GRANULITE TERRANE, SOUTHERN INDIA

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The Nilgiri granulite terrane in Southern India is predominantly composed of late Archaean medium- to coarse-grained enderbite to charnockitic rocks. The dominant regional foliation strikes N60-70E with generally steep dips. Tight minor isoclinal folds have been observed in places. Granoblastic polygonal microstructures are common and indicate thorough post-kinematic textural and chemical equilibration at conditions of the granulite facies (2.5 Ga ago (1)). The typical silicate assemblages of enderbites and charnockite are: plag+qtz+opx+gar+bio, plag+qtz+opx+hbl,cpx and plag+kfsp+qtz+opx+gar+bio. Late compressional deformation in connection with the formation of the Moyar and Bhavani shear zones to the north and south of the Nilgiri block, resulted in wide-spread development of weakly to strongly strained fabrics and was accompanied by minor rehydration.

Enderbites and charnockites range from tonalitic to granodioritic in composition. A magmatogenic origin of the protoliths is inferred from their chemical characteristics which resembles those of the andesitic to dacitic members of Cordillera-type calc-alkaline igneous suites. Their low abundances of U, Th, Rb, Zr (2 and this work), however, may be due to LILE depletion in connection with granulite facies metamorphism.

A significant lithological feature of the Nilgiri granulite terrane are numerous extended bodies, lenses and pods of gabbroic and pyroxenitic rocks which are aligned conformable to the foliation of the enderbite-charnockite complex and which have also been deformed and metamorphosed at granulite facies conditions (3).

The common pyroxenitic rocks are coarse-grained orthopyroxenes, websterites, hornblende- and garnet-hornblende pyroxenites with the following silicate assemblages: opx+cpx,hbl,plag; cpx+opx+hbl+plag,bio; hbl+opx+cpx,plag and cpx+opx+gar+hbl+plag,bio. The isolated occurrence of the pyroxenitic rocks and their chemical similarity with picritic basalts suggest that they could represent metamorphosed picritic dykes or sills rather than ultramafic cumulates (3). The low FeO^t, Cr and Ni abundances indicate fractionation of chromite and olivine from the parental magma. There is no compositional transition to the gabbroic rocks of the area.

Field relations, petrographic and geochemical characteristics allowed to distinguish two major groups of gabbroic rocks: (group 1) gabbroic to anorthositic two-pyroxene-plagioclase rocks, possibly representing fragments of differentiated igneous bodies and (group 2) ferroan garnet-pyroxene-plagioclase rocks constituting an individual series of NE-SW trending dyke-like gabbroic intrusions. Mafic granulites of this type occur also in the adjacent Moyar and Bhavani shear zones. The common

silicate assemblages are: (group 1) cpx+opx+plag+hbl+bio,kfsp; cpx+plag+hbl+bio and (group 2) cpx+opx+gar+plag+hbl+qtz,bio.

The lithological features and chemical variation of the two-pyroxene-plagioclase rocks (group 1) can be attributed to cumulus processes involving clinopyroxene and plagioclase. There are striking similarities in major and trace element abundances to the gabbros and anorthositic gabbros of the Bhavani layered complexes (4). The mafic garnet-pyroxene-plagioclase rocks (group 2) exhibit a moderate iron enrichment tholeiitic trend and have distinctly higher FeO^t and lower Al_2O_3 contents than the gabbroic rocks of group 1.

Apart from these gabbroic rocks, several bands of completely undeformed clinopyroxene-plagioclase-(olivine) rocks with conspicuous ophitic texture and relic igneous mineralogy represent a set of late dolerite dykes which were emplaced into the enderbite-charnockite complex after the main period of penetrative deformation but still at conditions of the granulite facies. This is evidenced by the formation of garnet coronas on plagioclase, clinopyroxene and opaque phases.

Metasediments are rare in the Nilgiri granulite terrane and confined to bands and lenses of light garnetiferous gneisses, kyanite- and garnet-bearing quartzites and banded magnetite quartzites with garnet and ferrohypersthene.

Recent isotope studies (1) on granulites of the Nilgiri massif indicate that granulite facies metamorphism occurred about 2.5 Ga ago and closely followed the emplacement of the igneous protoliths. These findings together with the available field, petrographic and geochemical criteria lead us to interpret the Nilgiri granulite complex as a Cordillera-type plutonic belt generated through northward subduction and welded to the Archaean Dharwar craton in the north during early Proterozoic times. Accordingly, the Moyar shear zone represents a major tectonic suture.

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